Validation of Cloud Parameters derived from the Nowcasting SAF Polar Platform System Software Package (PPS) using CloudSat and CALIPSO – And future plans

Adam Dybbroe, Ronald Scheirer and Anke Tetzlaff

http://nwcsaf.inm.es/
http://www.smhi.se/saf/

Introduction to NWCSAF

The Eumetsat Satellite Application Facility (SAF) project to support Nowcasting and Very Short Range Forecasting (NWCSAF) is a consortium of four national Met. Services (INM, Météo-France, ZAMG, and SMHI) with the Spanish Met. Service (INM) as the leading entity. Development of algorithms and software started in 1997, and the SAF entered into initial operations in 2002.

Both Geostationary (MSG/SEVIRI) and Polar orbiting satellite (NOAA & EPS/MetOp and soon NPP) data are considered.

The general objective of the NWCSAF is to provide operational services to ensure the optimum use of meteorological data in Nowcasting and Very Short Range Forecasting within the Eumetsat community.

The NWCSAF has just started the Continuous Development and Operational Phase (CDOP).

PPS goes global: Global MetOp and NOAA GAC
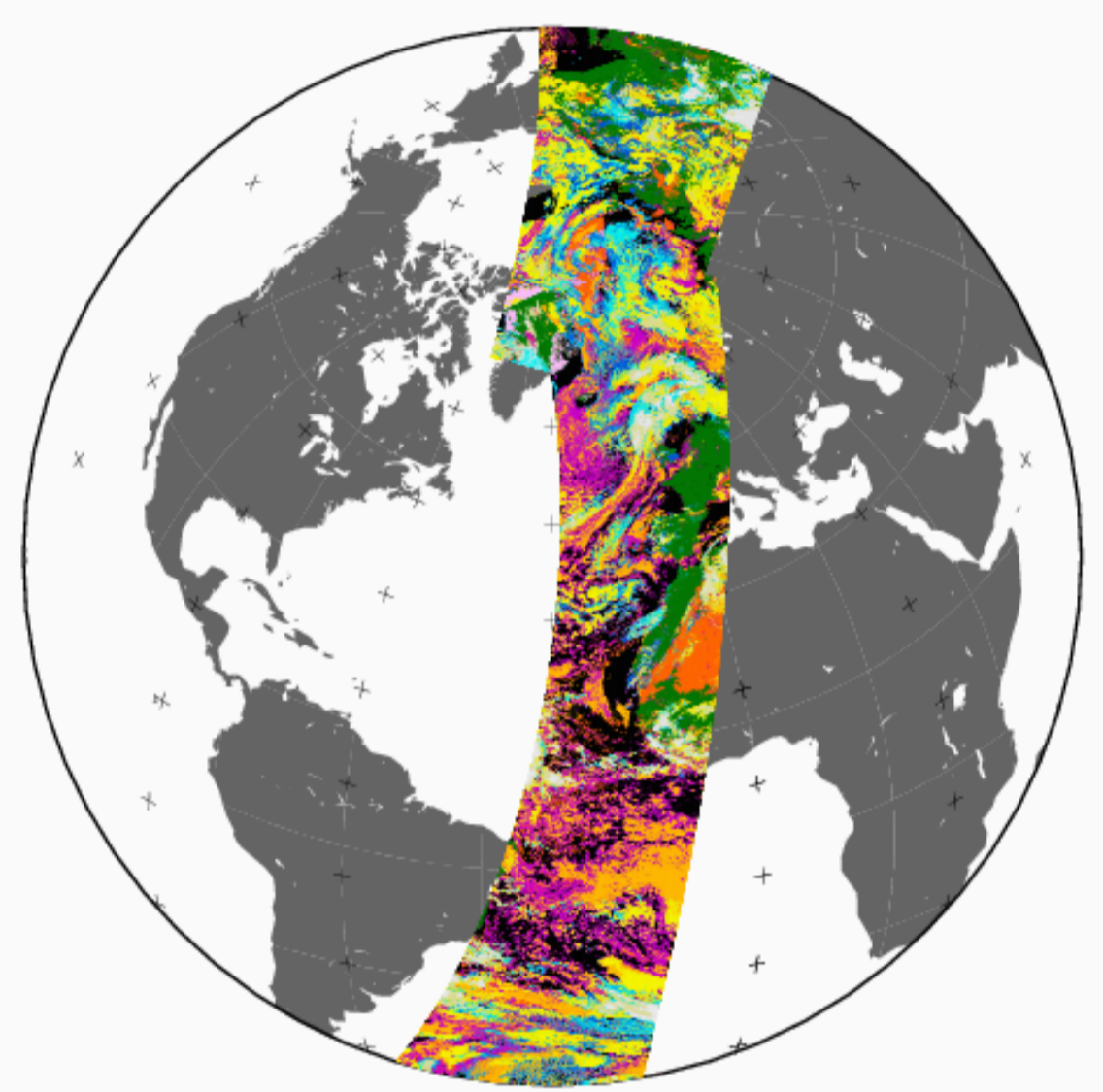
PPS Cloud Type, MetOp-A orbit (4712 & 4713) 16/9, 2007, EUMETCast reception

New features in PPS version 2008:

❏ Cloud Mask improvements over sea-ice:
- ❏ Entirely new nighttime scheme over sea-ice
- ❏ O&SI SAF Ice maps (MW based) as input (NWP as fall back)

❏ CTTH in satellite projection

❏ PC improvements: Implement results of tuning on one year of NORDRAD data, new estimation of background BT's over sea and land

❏ NOAA GAC interface

❏ Improved interfaces to Global MetOp processing

Future plans – further development

❏ Cloud Mask:
- ❏ Re-calculation of threshold tables (RTTOV-9 and ECMWF profile database)
- ❏ Adaptation to VIIRS (NPP & NPOESS)
- ❏ Improved auxiliary data

❏ Cloud Type:
- ❏ Adaptation to VIIRS
- ❏ Introduce microphysical parameters for VIIRS sensor
- ❏ Better consistency with CTTH product

❏ CTTH:
- ❏ Adaptations to RTTOV-9
- ❏ Improve CTTH assignment for semitransparent clouds by using sounder (IASI, HIRS, CrIS) information

❏ PC - MW:
- ❏ Possibly introduce additional rain rate information
- ❏ Adaptations to NPP

Acknowledgements:
- ▪ Global MetOp-A data © EUMETSAT. Kindly provided by Morten Lind (DMI)
- ▪ CALIPSO lvl 2 products from NASA Langley
- ▪ CloudSat lvl 2 products from the DPC at NASA

PPS Products

Cloud Mask – PGE01

Detects both cloud filled and cloud contaminated pixels. In addition the product provides information on the presence of snow and sea ice, when illumination conditions allow.

Cloud Type – PGE02

Detailed cloud analysis with information on the major cloud classes: fractional clouds, semitransparent clouds, high, medium, low clouds including fog, for all pixels identified as cloudy by the cloud mask.
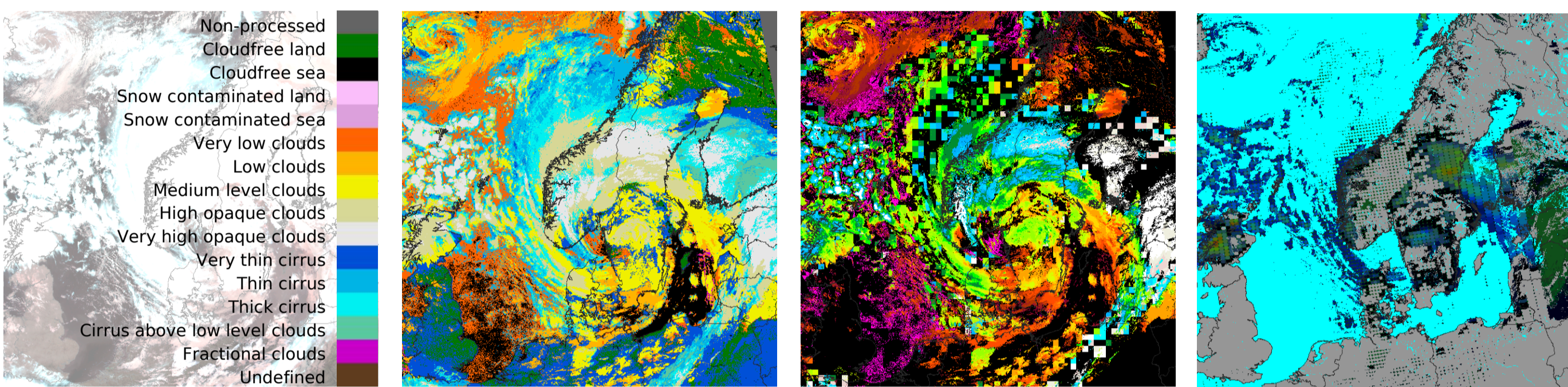
Cloud Top Temperature & Height (CTTH) – PGE03

Provides the top temperature, pressure, and height for all cloudy pixels The retrieval of semi-transparent clouds is based on AVHRR split-window histograms.

Precipitating Clouds – PGE04

Provides probability of precipitation intensities in predefined intensity intervals. This product takes as input both AVHRR and AMSU-A/B (MHS).

The storm 'Gudrun':

0 1 2 3 4 5 6 7 8 9 km

Non-processed
Cloudfree land
Cloudfree sea
Snow contaminated land
Snow contaminated sea
Very low clouds
Low clouds
Medium level clouds
High opaque clouds
Very high opaque clouds
Very thin cirrus
Thin cirrus
Thick cirrus
Cirrus above low level clouds
Fractional clouds
Undefined

AVHRR ch3,4,5 RGB | Cloud Type | CTTH – Height (m) | Precipitating Clouds RGB

N15 2005-01-08 16:50 UTC

Roadmap
Continuous Development and Operations Phase

Mar '07 — Continuous Development / Operations & Validation / Preparations for NPP/NPOESS / Upgrades according to User Feedback — Feb '07 — PPS 2.0

N-19 — Oct '07 — Patch

Feb '08 — PPS-v2008

User Workshop — Feb '09 — Release

NPP — Feb '10 — Release

VIIRS / CTTH: IASI / Cloud Microphysical parameters for VIIRS — Feb '11 — Release

MetOp-B — Feb '12 — Release

Validation of Cloud Mask & Cloud Top Height with CloudSat & CALIPSO

History: The PPS Cloud Mask and Type have been extensively validated in the past using more than five years of Synop data over Europe, using interactive targets, NORDRAD Weather radar data, and intercomparison studies with other operational schemes (MAIA and CLAVR-X)
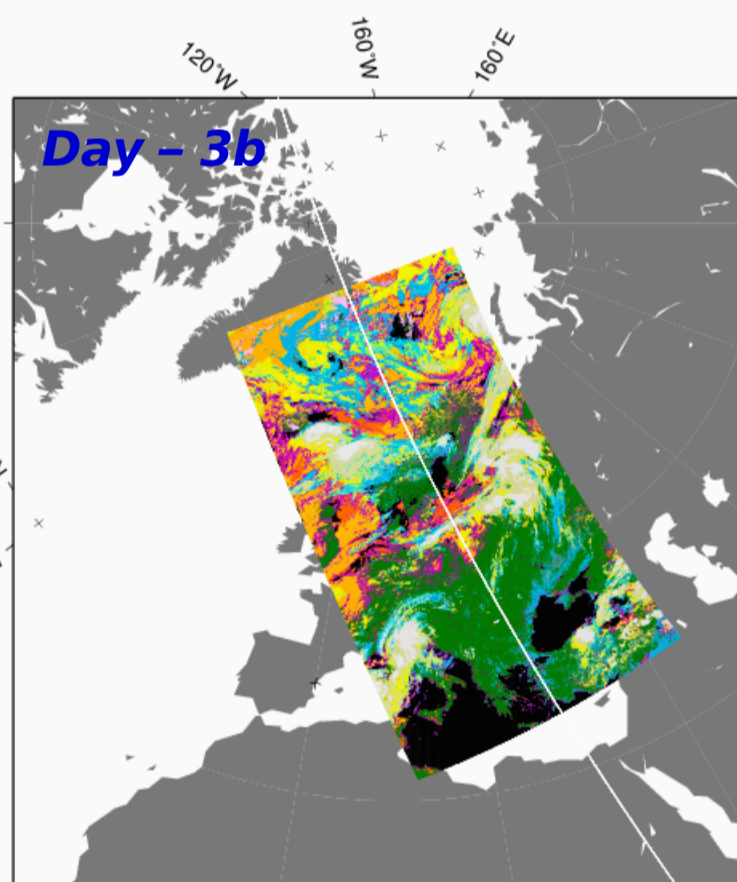
Today: The CloudSat and CALIPSO satellites of the EOS A-train provide a unique opportunity for an objective validation of all three PPS Cloud products on a global scale. This work has recently started.

CloudSat-CALIPSO-AVHRR matchups: Two N18 (night and day) scenes and one N17 (day) scene
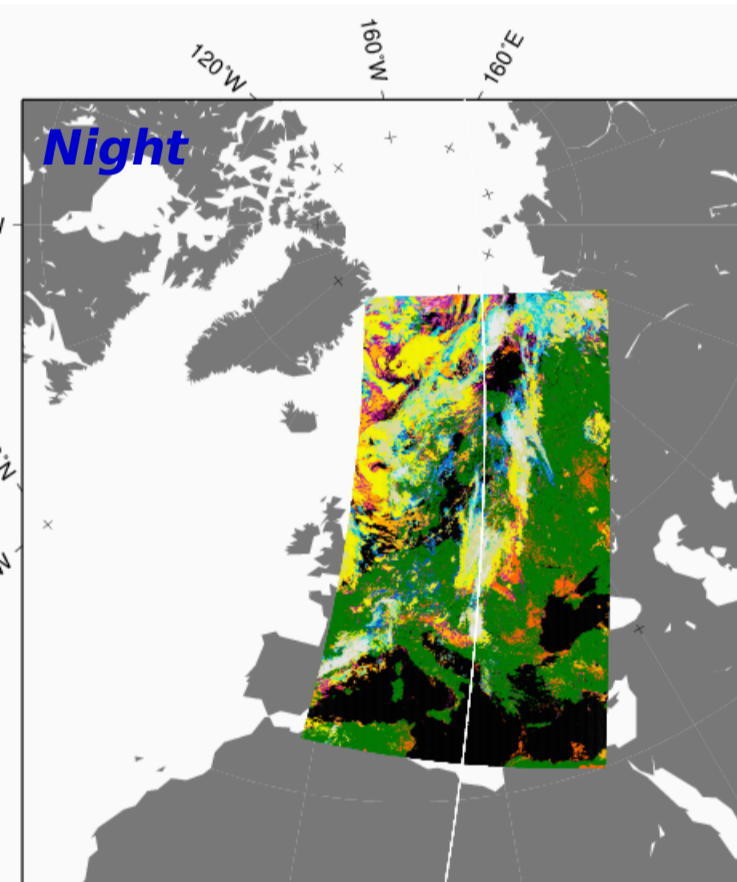
N17 Daytime Δt = [6,16] min	PPS clear	PPS Cloudy
CloudSat clear	660	844
CloudSat cloudy	38	1380

N18 Daytime Δt = 5 min	PPS clear	PPS Cloudy
CloudSat clear	1766	1244
CloudSat cloudy	181	1881

N18 Nighttime Δt < 1 min	PPS clear	PPS Cloudy
CloudSat clear	1843	434
CloudSat cloudy	192	2462

N17 Daytime Δt = [6,16] min	PPS clear	PPS Cloudy
CALIPSO clear	548	150
CALIPSO cloudy	202	2242

N18 Daytime Δt = 5 min	PPS clear	PPS Cloudy
CALIPSO clear	1956	495
CALIPSO cloudy	175	2827

N18 Nighttime Δt < 1 min	PPS clear	PPS Cloudy
CALIPSO clear	1747	26
CALIPSO cloudy	442	3088

Day - 3b | Night | Day - 3a
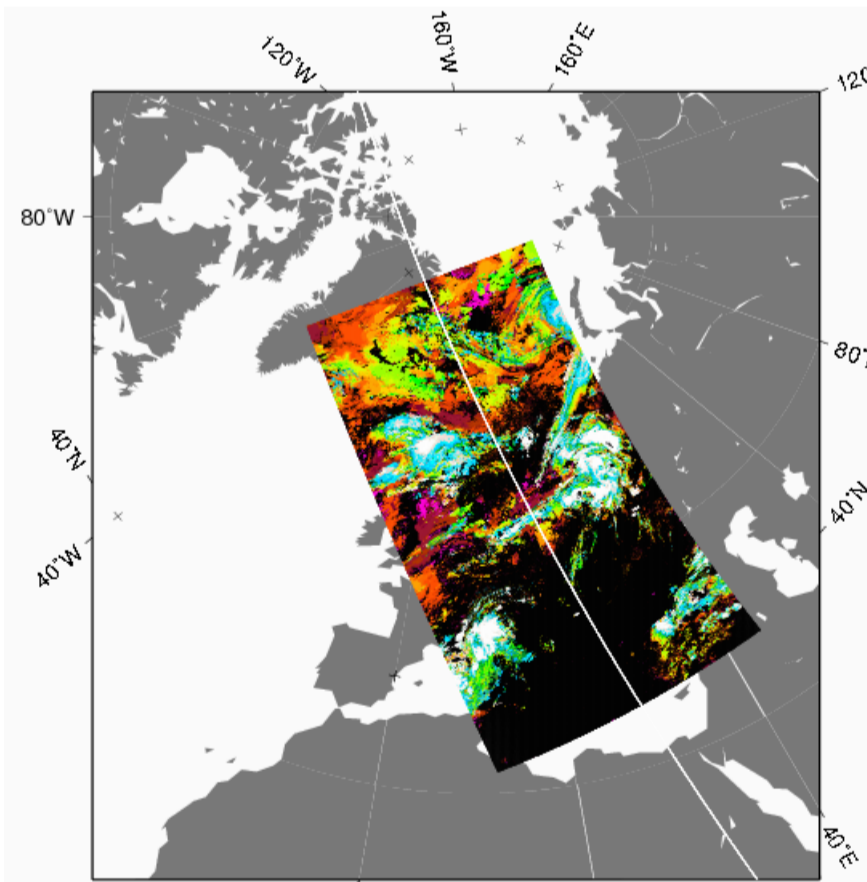
NOAA 18, 24/8, 2007 11:21 UTC | *NOAA 18, 18/8, 2007 00:47 UTC* | *NOAA 17, 31/5, 2007, 09:24 UTC*

AVHRR-CloudSat Cloud heights

NOAA 18, 24/8, 2007 11:21 UTC
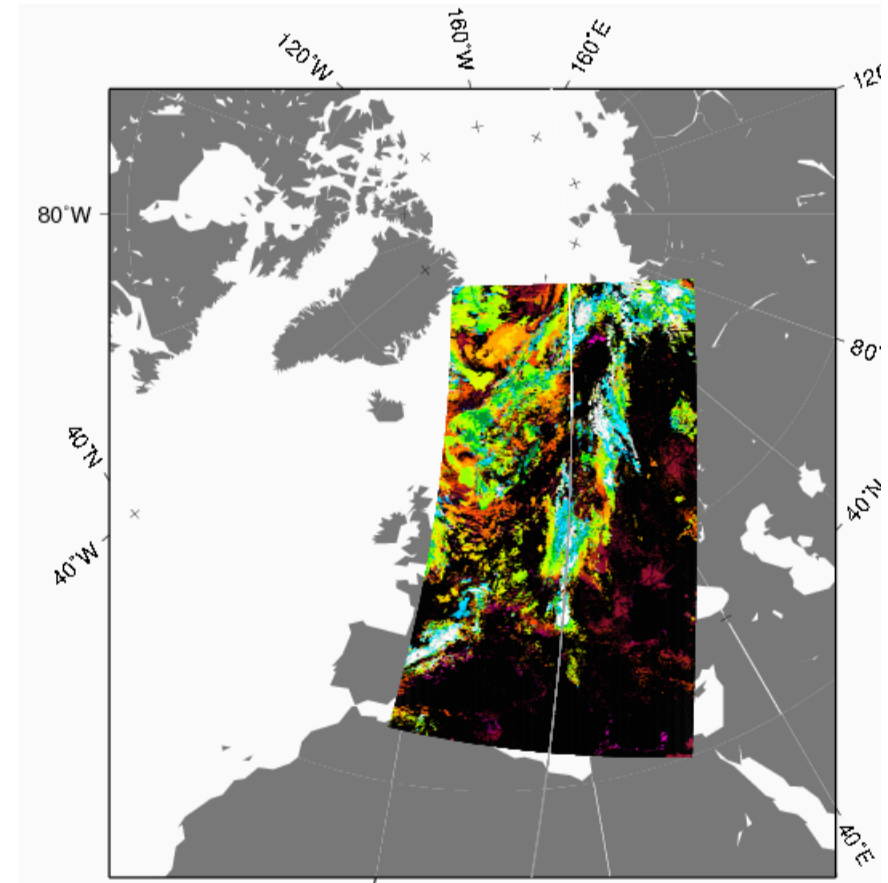
0 1 2 3 4 5 6 7 8 9 km
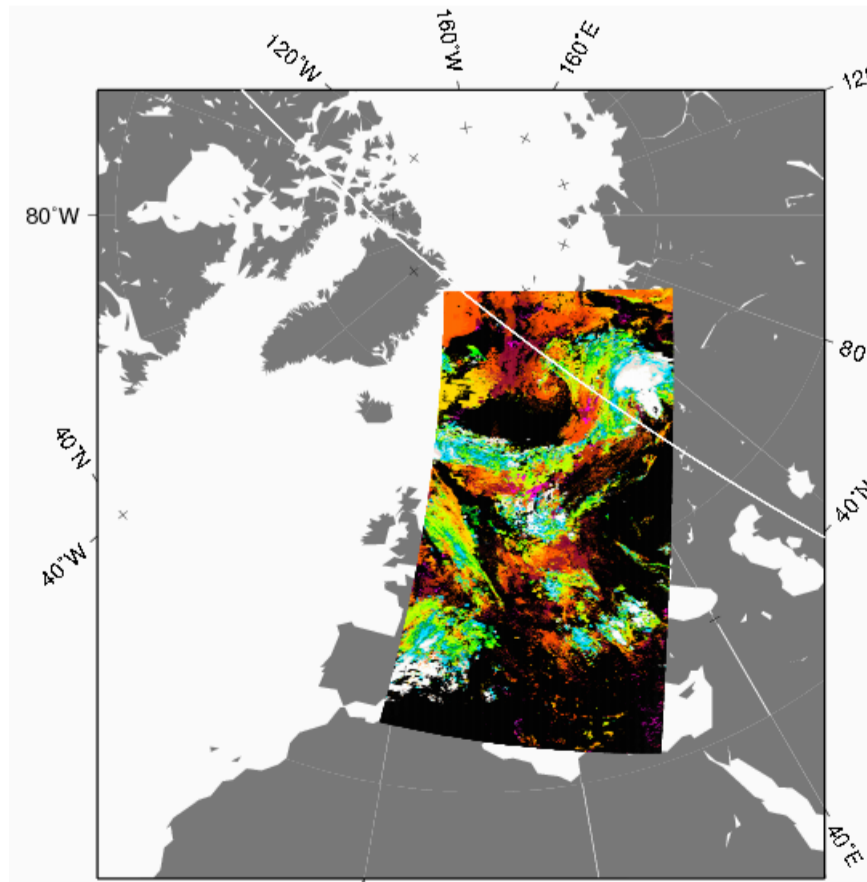
NOAA 17, 31/5, 2007, 09:24 UTC
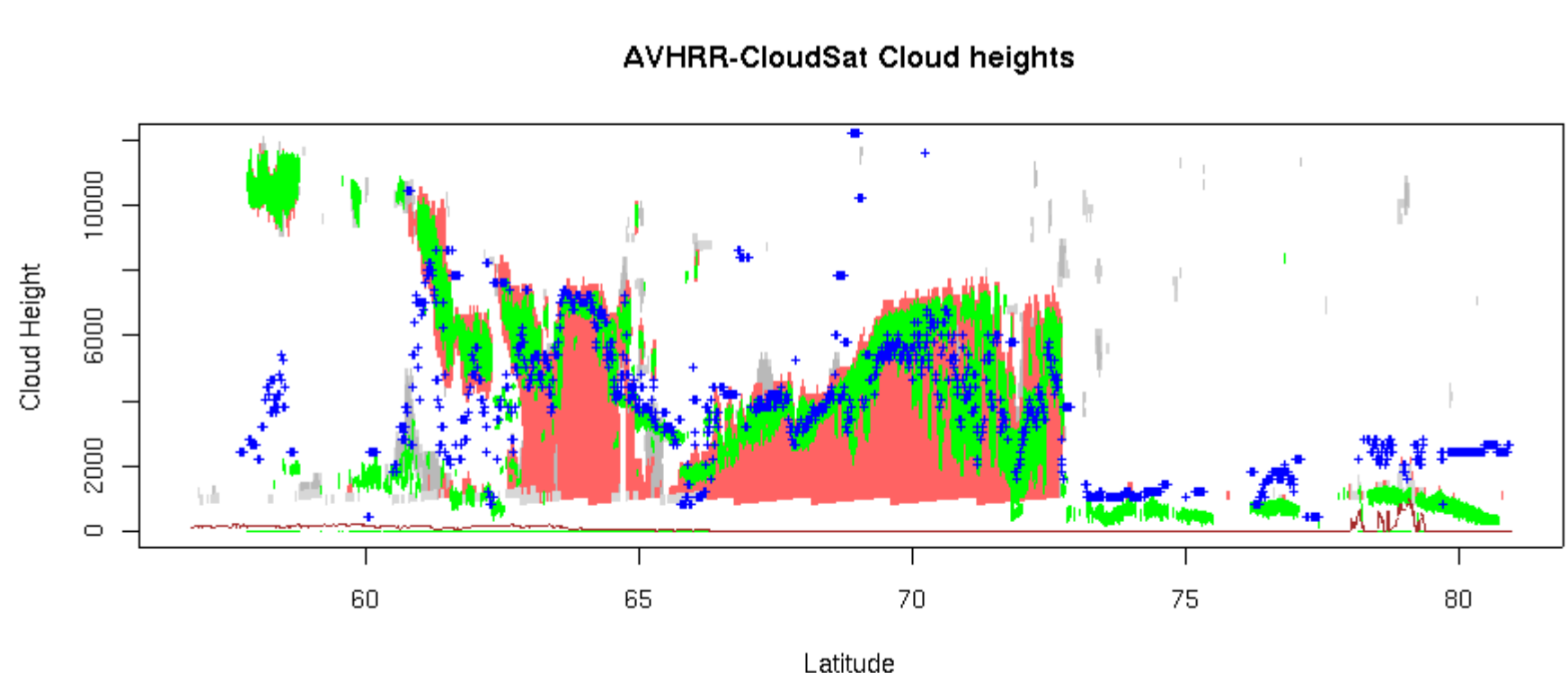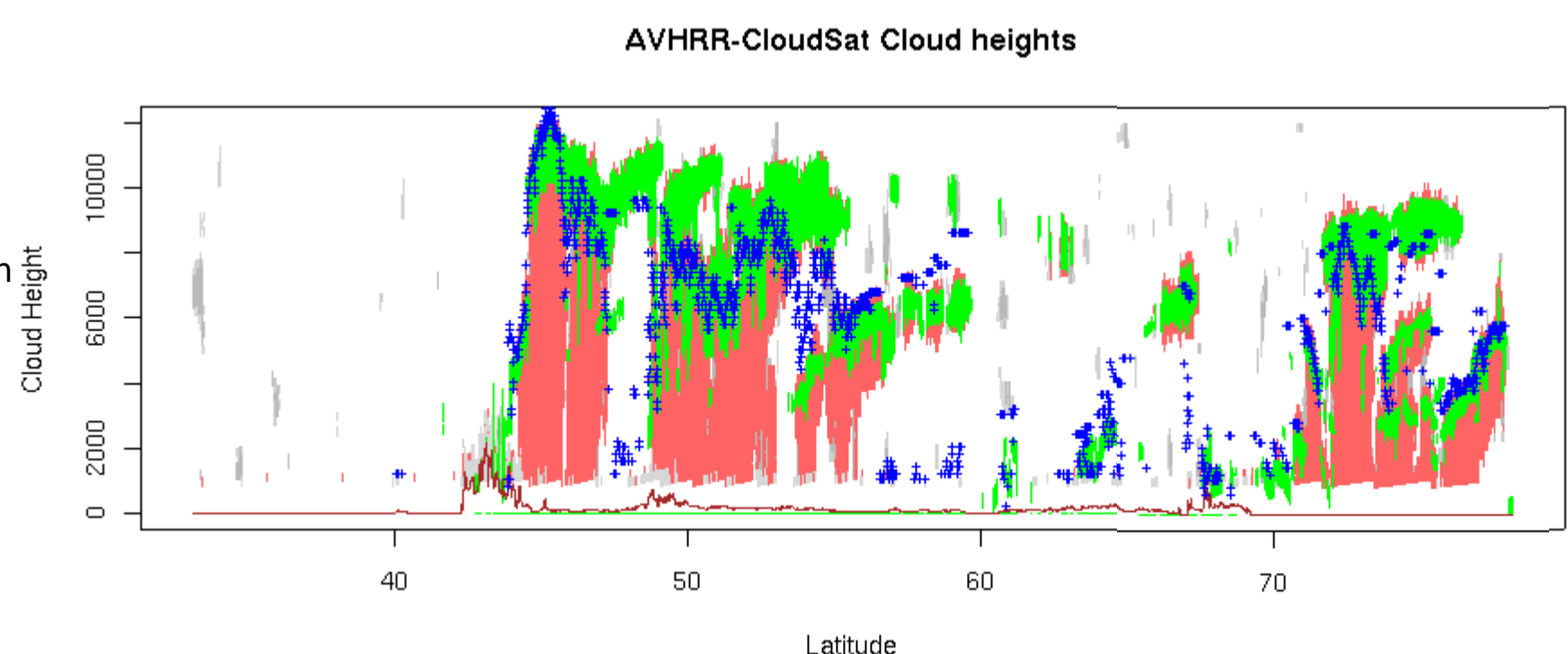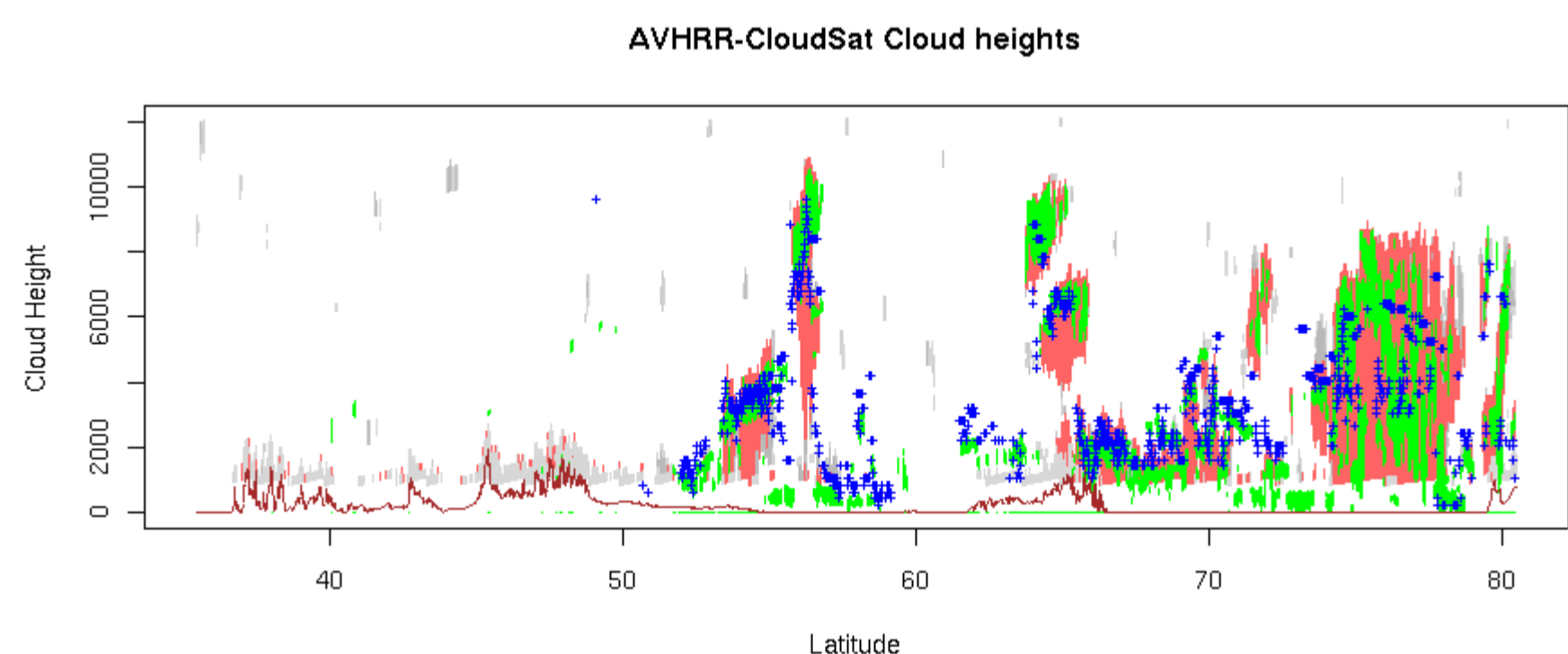
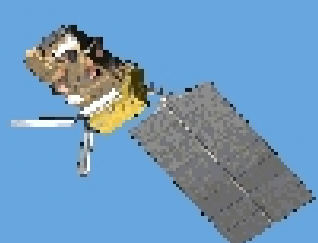**Comparison using CloudSat Lvl2 GEOPROF (release 4: R04), Calipso Lvl2 V1 10 layer profile, and AVHRR PPS-v2008:**
- **Blue +**: PPS Cloud Height (m)
- **Red**: CloudSat CPR-Cloudmask> 30
- **Green**: CALIPSO Lidar cloud layers
- **Brown**: USGS DEM elevation

NOAA 18, 18/8, 2007 00:47 UTC

Summary: PPS Cloudmask show probability of detection (POD) above 90% at daytime and around 88% for nighttime using CALIPSO. Using CloudSat this is well above 90% for all three cases. PPS Cloud Height performs overall well, but in general underestimates the height, in particular when compared to CALIPSO.

Further work: Analyse more scenes, including Metop-A. Focus on Arctic and global performance.

Adam.Dybbroe@smhi.se

SMHI

S A F — N W C — E U M E T S A T
INM - METEOFRANCE - SMHI - ZAMG